United States Department of the Interior

OFFICE OF THE SECRETARY

OFFICE OF MANAGING RISK AND PUBLIC SAFETY
755 PARFET STREET, RM 364, LAKEWOOD, COLORADO 80215

Memorandum

Date: May 30, 2008

To: Safety Manager, Yellowstone National Park

From: Industrial Hygienist, Department of the Interior, Office of Occupational Health and Safety

Subject: Exhaust Exposure Monitoring at West Yellowstone Entrance Station

Summary:

This data shows that entrance station employees' exposures to contaminants in snowmobile exhaust and to noise is very low compared to accepted occupational exposure limits. The current snowmobile policy, the kiosk ventilation system, and current work practices are effective in minimizing entrance station employee exposures to exhaust and to excess noise levels. The ventilation system of the new entrance station should be evaluated to ensure sufficient face velocity at the window. More noise dosimetry data is required to evaluate employee noise exposure for snowmobile riders.

An exposure assessment of the entrance station employees was conducted during President's Day weekend of 2008. This is part of an ongoing effort to ensure employee exposures are within an acceptable range during peak snowmobile use periods. The survey included personal exposure measurements of carbon monoxide, hydrocarbons, aldehydes and noise levels.

To evaluate employee exposure to contaminants, personal sampling was conducted to quantify contaminants within the employee's breathing zone. Low flow sampling pumps were calibrated before and after each work shift. Activated charcoal tubes were used as the sampling media for the volatile organic compounds and XAD-2 treated with 2-hydroxymethyl-piperidine were used for the aldehyde sampling. These samples were sent to the Wisconsin Occupational Health Laboratory for analysis using gas chromatography. Carbon monoxide concentrations were measured using Biosystems Toxiultra direct reading, data loggers with electrochemical sensors. This instrument records the peak exposures and also the time-weighted average exposures. This instrument was zeroed and calibrated using 100 ppm calibration gas prior to use. Noise exposures were monitored using Quest Q-300 noise dosimeters which integrate sound level exposures over the length of the work shift giving a time-weighted average exposure. Employees at the entrance station and two employees on snowmobiles were monitored over the weekend. Entrance station employees worked in the kiosk and interacted with the snowmobile guides through the kiosk window. Sampling was conducted for the duration of their work in the kiosks. Eight hour time-weighted averages were calculated assuming zero exposure for the unsampled time away from areas of exposure.

Weather conditions during the survey were clear and sunny with temperatures ranging from -24 degrees Fahrenheit in the mornings to +10 degrees in the afternoon. The air was still with no measurable wind.

The personal sampling results showing the time-weighted average for the sampling period and the calculated 8-hr time weighted averages are shown in the table below. The 8-hr time-weighted average can be compared to the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) which are the regulatory limits. The American Conference of Governmental Industrial Hygienists (ACGIH) is an industry standard setting organization and is usually more stringent than the regulatory limits of OSHA. The ACGIH Threshold Limit Values are also listed for comparison in the table.

All results for all volatile organic compounds, aldehydes, and carbon monoxide were well below the occupational exposure limits and in most cases were below the detection limits of the analytical method. Results of volatile organic compounds showed most were below detection limit with the relative highest exposure being to benzene which was approximately 2% of the PEL. Carbon monoxide exposures were measurable on employees riding snowmobiles, but were also relatively low with a maximum time-weighted average concentration of 6 ppm or approximately 10% of the PEL.

Three of the nine aldehyde samples had detectable levels of formaldehyde for the analytical method used in this survey. The limit of detection was 1 ug/sample. Two of the three samples above the detection limit were from the employee in Kiosk 1. These measurements were only approximately 2-3% of the OSHA PEL (5-7% of the ACGIH TLV). No other aldehydes such as Acrolein and Acetaldehyde were above the detection limit. Maintaining adequate positive pressure ventilation and minimizing time outside of the kiosk when snowmobiles are idling will keep these exposures low.

The current snowmobile policy for the Park mandates snowmobiles be equipped with the best available control technology to reduce CO and hydrocarbon emissions, requires guided visits, and limits the number of snowmobiles entering the Park. The effect of the policy on reducing exposures is evident by the reduction in carbon monoxide measurements. Previous carbon monoxide sampling conducted by DOI Health and Safety Office prior to the current policy resulted in exposure levels up to 18 parts per million (ppm) for a 4 hour sample with peak readings exceeding 200 ppm. The carbon monoxide results from this survey showed time-weighted average exposures to be zero ppm for the entrance station employees with instantaneous peak readings of only 6 ppm. Employees on snowmobile patrols had a time-weighted average of 6 ppm. These concentrations are well below the occupational exposure limits of 50 ppm and are significantly reduced from the previous DOI sampling report.

The existing ventilation system has an overhead duct with the intake located sufficiently far enough away from the roadway to prevent intake of exhaust. The measured air flow velocity was approximately 105 linear feet per minute at the window opening. The volume of air coming into each kiosk was approximately 550 cubic feet per minute. Maintaining positive pressure in the kiosk reduces exposure to the employee at the window opening. The new entrance station was under construction at the time of this survey. The new kiosk should be designed with sufficient flow to maintain the positive pressure in the booth providing at least 100 linear feet per minute velocity at the window opening.

Noise exposure is compared to the OSHA 8-hr time-weighted average "action level" of 85 dBA and the PEL of 90 dBA. All data collected during this survey suggests that entrance station employees do not exceed the action level or the PEL and therefore entrance station employees are not required by OSHA to be included in the Park's hearing conservation program. During the first day of noise monitoring on the Law Enforcement Officer during snowmobile patrol the dosimeter malfunctioned resulting in an error with the data. A maintenance employee was monitored the following day riding a four stroke snowmobile and his full shift exposure was very close to the OSHA action level of 85 dBA. This particular activity needs further monitoring to determine whether employees who ride snowmobiles for a significant part of their work shift need to be included in a hearing conservation program. This should be the focus of future personal exposure monitoring.

Noise Exposure Results

Personal Sample	Date	Decibels (dBA) Time-weighted Average
Personal Sample Inside Kiosk 1	2/16	70.2
Personal Sample Inside Kiosk 2	2/16	67.3
Personal Sample Inside Kiosk 1	2/17	68.0
Personal Sample Inside Kiosk 2	2/17	70.6
Personal Sample Inside Kiosk 1	2/18	67.1

Personal Sample Inside Kiosk 2	2/18	70.7
Personal Sample Patrol on 4 stroke snowmobile	2/18	84.5

Traffic Volume

Date	Snow Coaches	Snowmobiles	Other (non reportable)
2/16	26	261	17
2/17	21	239	8
2/18	24	191	10

Recommendations:

- Ensure sufficient ventilation in new entrance stations. Face velocity at window during normal operation should be a minimum of 100 feet per minute.

- Further evaluate noise exposures for employees who ride snowmobiles for a significant amount of their workshift.

If you have questions concerning this report or the exposure assessment methods, please feel free to contact Tim Radtke CIH at (303)236-7130.

Time-weighted Average for time sampled (calculated 8-hr TWA) Volatile Organic Compounds Sample Results in Parts Per Million

Sample	Date (sample duration in minutes)	Acetone	Benzene	Ethyl Alcohol	Ethyl Benzene	Isopropyl Alcohol	Naptha	Petroleum Distillates	Toluene	Xylene	Carbon Monoxide
CKE-1 Personal sample Inside Kiosk 2	2/16 (318)	0.013 (0.009)	BDL	0.21 (0.014)	BDL	BDL	0.066 (0.044)	0.039 (0.026)	BDL	BDL	0
CDD-1 Personal Sample Inside Kiosk 1	2/16 (315)	BDL	BDL	0.12 (0.079)	BDL	0.61 (0.400)	0.028 (0.018)	0.018 (0.012)	BDL	BDL	0
CDD-2 Personal Sample Inside Kiosk 1	2/17 (220)	BDL	BDL	BDL	BDL	BDL	0.020	0.030	BDL	BDL	
CCG-1 Personal Sample Kiosk 2	2/17 (218)	BDL	BDL	BDL	BDL	0.085 (0.035)	0.041 (0.017)	0.039 (0.016)	BDL	BDL	0
CA-1 Area Sample Outside Kiosk 1	2/17 (213)	BDL	BDL	BDL	BDL	BDL	BDL	0.039 (0.017)	BDL	BDL	5 (2.22)
CJF-1 Personal Sample Patrol 4 stroke Articat	2/18 (450)	BDL	BDL	0.079 (0.074)	BDL	BDL	0.025 (0.023)	0.033 (0.031)	BDL	BDL	3 (2.81)
CCE-3 Personal Sample Inside Kiosk 2	2/18 (263)	BDL	BDL	BDL	BDL	BDL	BDL	0.012 (0.006)	BDL	BDL	0
CDD-3 Personal Sample Inside Kiosk 1	2/18 (263)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0
CTW-1 Personal Sample Patrol Polaris 2 stroke	2/17 (380)	BDL	0.021 (0.017)	0.058 (0.046)	0.008 (0.006)	BDL	0.045 (0.036)	0.58 (0.459)	0.047 (0.037)	0.039 (0.031)	6 (4.75)
OSHA Permissible Exposure Limit		1000	1.0	1000	100	400	100	300	200	100	50
American Conference of Governmental Industrial Hygienist Threshold Limit Value		500	0.5	1000	100	400	n/a	n/a	50	100	25

BDL: below detection limit

Aldehyde Sample Results in Parts Per Million for time sampled (calculated 8-hr TWA)

Sample Number	Date (sample duration)	Formaldehyde ppm	Acetaldehyde ppm	Acrolein ppm
AKE-1 Personal Sample Inside Kiosk 2	2/16 (318)	BDL	BDL	BDL
ADD-1 Personal Sample Inside Kiosk 1	2/16 (315)	BDL	BDL	BDL
CDR-1 Personal Sample Patrol 2 stroke	2/17 (384)	BDL	BDL	BDL
ADD-2 Personal Sample Inside Kiosk 1	2/17 (220)	0.037 (0.017)	BDL	BDL
ACG-1 Personal Sample Inside Kiosk 2	2/17 (218)	BDL	BDL	BDL
AA-1 Area Sample Outside Kiosk 1	2/17 (213)	BDL	BDL	BDL
AJF-1 Personal Sample Patrol 4 stroke Articat	2/18 (450)	0.018 (0.017)	BDL	BDL
ACE-3 Personal Sample Inside Kiosk 2	2/18 (263)	BDL	BDL	BDL
ADD-3 Personal Sample Inside Kiosk 1	2/18 (263)	0.043 (0.023)	BDL	BDL
OSHA Permissible Exposure Limit		0.75 / 2.0*	200	0.1
American Conference of Governmental Industrial Hygienist Threshold Limit Value (TLV)		0.3**	25**	0.1**

BDL: below detection limit

*Short Term Exposure Limit ** Ceiling Limits